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(54) Title: CONDITIONING COMPOSITIONS

## (57) Abstract

An improved conditioning composition for e.g. humain hair is formed by admixture of an aqueous emulsion of a polydiorganosiloxane which is preferably a linear polydimethylsiloxane or polymethylphenylsiloxane, and a quaternary ammonium silane of the general formula (ii)  $R^3_3SiR^4N^+(R^5)_3X^-$  having preferably one aliphatic C<sub>8-18</sub> group and 2 aliphatic C<sub>1-5</sub> groups linked to the N atom. The composition can be used as a rinse conditioner or may be incorporated in a shampoo composition.

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### CONDITIONING COMPOSITIONS

This invention is concerned with conditioning compositions and is particularly concerned with conditioning compositions for human hair.

It has become a common practice to wash human hair frequently in order to clean it, and it is normal to use for this purpose a shampoo containing a synthetic detergent. There are many shampoo formulations available which are effective to clean the hair, but generally the detergents employed have a tendency to leave the hair in a condition such that it is difficult to comb when wet and somewhat unmanageable when dried. It has therefore also become a practice to apply conditioner materials to the hair which are intended to improve the properties of the shampooed hair. These materials may be applied to the hair in admixture with the shampoo or applied to the wet shampooed hair as a separate conditioner, for example as a rinse.

Various proposals have been made concerning the formulation of compositions intended for use, for example, on human hair with a view to conditioning the hair, i.e. imparting to the hair one or more desirable properties, for example, ease of combing or detangling of wet hair, or ease of combing, lustre, a fullness or body accompanied by a certain liveliness, manageability and avoidance of static in the dried hair. Such compositions may take the form, for example, of shampoos, conditioners or rinses, and all such compositions are referred to herein as conditioning compositions. It is a common practice to employ surfactants such as stearyldimethylbenzylammonium chloride, cetyltrimethylammonium bromide and dimethylbis(hydrogenated tallow)ammonium chloride, for their hair conditioning

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properties. These materials are effective in many respects but in order to provide some of the desired properties, it is necessary to employ significant amounts of the surfactant and as a consequence other properties are impaired.

5 This in turn has led to proposals to include significant proportions of other selected ingredients in conditioning compositions to impart softness and other properties to the hair. It has been proposed, for example, to employ certain polydiorganosiloxanes to impart increased softness to the

10 hair. Other proposals have been made to employ in hair treating compositions certain organosilicon compounds having quaternary ammonium salt groups. For example, hair treating compositions comprising certain silanes or polysiloxanes having quaternary ammonium groups in combination

15 with polysiloxanes having certain amino groups are described and claimed in G.B. patent specification 2 144 329. These compositions are effective to provide a variety of desirable properties to shampooed hair but it is recommended that they are not used frequently on the hair due to a tendency of the polysiloxanes having amino groups to adhere strongly to the hair for a considerable time and to resist removal during normal shampooing. Also, the polysiloxanes having siloxane units including quaternary ammonium salt groups generally require a series of preparation steps

25 and their manufacture can be costly.

It is one of the objects of the present invention to provide an improved conditioning composition. It is another of the objects of the invention to provide an improved method of treating hair.

30 We have now found that a conditioning composition capable of imparting a range of beneficial properties to human hair may be provided by an aqueous composition based on certain selected polydiorganosiloxanes and selected silanes having quaternary ammonium salt groups.

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The present invention provides in one of its aspects a conditioning composition formed by admixture of components comprising (a) an aqueous emulsion of a polydiorganosiloxane having units of the general formula  $R'R_2SiO_{\frac{1}{2}}$  and  
5  $R_aSiO_{\frac{4-a}{2}}$  in which R is selected from the group consisting

of alkyl and aryl groups having no more than 8 carbon atoms, R' is selected from R groups and hydroxyl and a is an integer with a value of from 0 to 2, with (b) a quaternary ammonium compound characterised in that the quaternary ammonium compound is a quaternary ammonium silane of the general (ii)  $R_3^3SiR^4N^+(R^5)_3X^-$  in which each  $R^3$  is selected from the group consisting of alkyl groups having up to 5 carbon atoms in their chain, a hydroxyl group, alkoxy groups, alkoxyalkoxy groups having less than 12 carbon atoms, and a trimethylsiloxy group,  $R^4$  represents a divalent aliphatic hydrocarbon group having from 2 to 10 carbon atoms in its chain linking the silicon and nitrogen atoms and composed of carbon, hydrogen, optionally oxygen in the form of ether linkages, each  $R^5$  represents a monovalent hydrocarbon group, from 1 to 2 groups  $R^5$  having an aliphatic chain composed of on average from 8 to 18 carbon atoms and from 1 to 2 groups  $R^5$  having an aliphatic chain composed of not more than 5 carbon atoms and  $X^-$  represents a monovalent anion.

Component (a) is an oil-in-water emulsion of a polydiorganosiloxane compound. Suitable polydiorganosiloxanes are those which can be provided in emulsions either by emulsion polymerisation or by mechanical emulsification. Preferred polydiorganosiloxanes are linear polymers wherein a has a value of 2 and which have the average general formula (i)  $R'SiR_2[OSiR_2]_nOR_2SiR'$ , wherein R and R' are as

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defined above and n is an integer. The groups R are preferably at least predominantly methyl but may include phenyl or other aromatic groups as aforesaid. Polydiorganosiloxanes in which at least substantially all R groups are methyl groups preferably have a viscosity of at least 1000 mm<sup>2</sup>/s at 25°C and preferably less than about 300,000 mm<sup>2</sup>/s; preferably they have a viscosity of from 10,000 to about 200,000 mm<sup>2</sup>/s at 25°C, most preferably from 12,500 to 100,000 mm<sup>2</sup>/s at 25°C. Polydiorganosiloxanes in which more than about 10% of the R groups are phenyl and less than 90% are alkyl groups preferably have a viscosity in the range of about 10 to about 1000 mm<sup>2</sup>/s at 25°C. The emulsion, in which the polydiorganosiloxane is provided may be made by mechanically emulsifying a polydiorganosiloxane of required viscosity according to methods which are well known in the art. Polydiorganosiloxanes which may be thus emulsified are well known, and many are commercially available. They may be prepared for example by the hydrolysis of halogenosilanes or by equilibration of cyclic diorganosiloxanes with monofunctional silanes. Alternatively the emulsion may be made by emulsion polymerisation, as is described for example in British Patent Specification 992 087. The latter method is particularly preferred for the higher viscosity polydiorganosiloxanes. Emulsions made by the emulsion polymerisation technique are usually more stable and have a smaller particle size than the emulsions which are made by mechanical emulsification. Polydiorganosiloxanes made via the emulsion polymerisation technique usually have a structure in which each R' represents a hydroxyl group. Emulsions which are useful in the present invention may have a solids content of up to about 75%, but preferably contain from about 10% to about 40% by weight polydiorganosiloxane. The amount of emulsion (a) in a

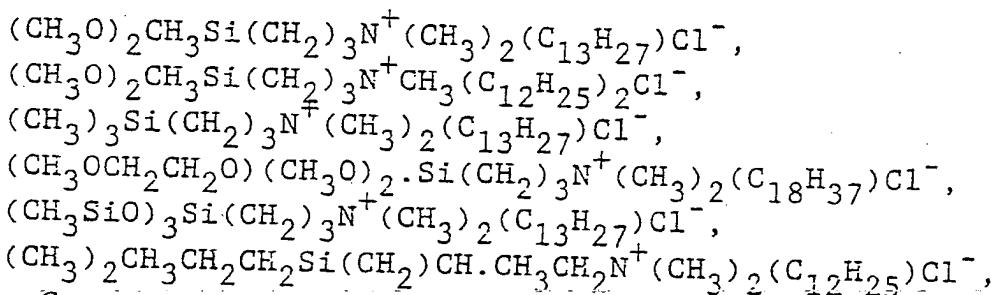
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composition according to the invention is such that up to 2% by weight of the polydiorganosiloxane is utilised in the composition although it is preferred to use no more than 1% of the polydiorganosiloxane if its viscosity is in the more preferred ranges mentioned above.

In a composition according to the present invention the component (b) is a quaternary ammonium silane of the formula (ii). Preferably at least one of the groups R<sup>3</sup> is an alkyl group, preferably a methyl group and up to two of the groups R<sup>3</sup> are alkoxy groups, preferably methoxy groups. The quaternary ammonium silanes are known materials and may be prepared in various ways, for example as disclosed in G.B. patent specifications 1 117 592 and 2 107 715. We prefer to prepare them from the corresponding tertiary amine and chlorosilane, trialkyl chlorosilanes are preferred over those containing readily hydrolysable groups, for example alkoxy and alkoxyalkoxy groups, thus avoiding production of disiloxanes and trisiloxanes during conversion of the silane to the quaternary ammonium salts.

The group R<sup>4</sup> may be for example -(CH<sub>2</sub>)<sub>3</sub>- , -(CH<sub>2</sub>)<sub>4</sub>- , -CH<sub>2</sub>CH<sub>2</sub>CHCH<sub>3</sub>CH<sub>2</sub>- or -(CH<sub>2</sub>)<sub>6</sub>- and the groups R<sup>5</sup> may be chosen for example from methyl, ethyl, propyl, decyl, dodecyl, tetradecyl and octadecyl. Preferably one only of the groups R<sup>5</sup> has a longer aliphatic chain. We prefer that two of the groups R<sup>5</sup> are methyl groups and one of them has an aliphatic chain having on average about 12 to 14 chain carbon atoms. The nature of the anion X<sup>-</sup> influences the solubility of the silane; whilst many organic and inorganic anions may be employed depending on the surfactant used in the emulsion, for example acetate, bromide and iodide, we prefer to employ the chloride ion. Examples of suitable quaternary ammonium silanes include those of the formulae

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Component (b) of a composition according to the invention is water soluble and may be readily incorporated with component (a) by a simple mixing procedure.

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Components (a) and (b), when mixed in the required proportions provide an aqueous emulsion which may be readily supplied to the hair. The emulsion may be formulated into a form in which it is stable for a short period but unless appropriate surfactants and stabilizers are included in the formulation, the emulsion is likely to be unstable in storage and it is then preferable to store the components separately and to mix them in desired proportions shortly before use.

20

A composition according to the invention may, and preferably does, contain at least one surfactant which functions to stabilize the emulsion and maintain the polydiorganosiloxane in the dispersed state in the aqueous medium. The nature of the surfactant is not critical; preferably it is cationic or nonionic. Examples of surfactants are aliphatic fatty amines and their derivatives e.g. octadecylamine acetate and quaternary ammonium halides, sulphonic acids e.g. dodecyl benzene sulphonic acid, ethylene oxide adducts of octyl or nonyl phenols e.g. octylphenoxypolyethoxyethanol, condensation products of aliphatic alcohols and ethylene oxide, monoesters of alcohols and fatty acids e.g. sodium lauryl sulphate glyceryl stearate, sorbitan monolaurate and polyoxyethylenemonostearate, and polyvinyl alcohol. The

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surfactant component is generally employed in amounts of about 0.01% to about 5% by weight of the composition.

In a composition according to the invention, the silane (b) is preferably present in excess of about 0.25% by weight of the composition in order to achieve the desired low level of static for the treated hair. Larger proportions may be used to give increased static control but it is generally not necessary to employ more than about 5% of the silane in the composition. The polydiorganosiloxane provided in component (a) is present principally to contribute softness and related properties. When using the lower molecular weight polydiorganosiloxanes, the amount employed is greater than when the higher molecular weight polydiorganosiloxanes are employed. In order to secure the desired blend of properties we prefer to employ the materials of the general formulae (i) and (ii) in proportions such that the ratio by weight of polydiorganosiloxane:silane is less than about 2.5:1, more preferably lies in the range 0.1:1 to 2:1. If the ratio lies outside this range, the reduction in static and the combination of properties achieved is inferior.

It is not necessary to include any ingredients in a conditioner composition intended for use as a rinse for the hair in addition to components (a) and (b). However, if desired, the composition may include other ingredients as stabilisers, for example non-ionic surfactants as aforesaid, thickeners e.g. carboxymethyl cellulose, hydroxypropyl cellulose and guar gum, colorants, perfumes, bactericides, solvents, preservatives, and conventional hair conditioning ingredients e.g. handle modifiers eg fatty acid salts esters and ethers and long chain alkyl alcohols, waxes, oils and organic quaternary compounds. In addition, the composition may be formulated as a shampoo by the

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inclusion of suitable sequestering agents and detergents for the cleaning of hair, for example those based on fatty alcohols e.g. lauryl and myristyl alcohols, or fatty alcoholethoxylates. Examples of such detergents are sodium 5 lauryl sulphate, sodium lauryl ether sulphate, ammonium lauryl sulphate and triethanolamine lauryl sulphate. The surfactant chosen for the emulsification of the polysiloxane may in some cases function also as the detergent component of the shampoo formulation. When so formulated, 10 the proportion of the surfactant used will normally be much larger than the amount used to provide the stability of the emulsion.

Also included within the scope of the invention is a process for the treatment of hair which comprises applying 15 thereto a composition according to the invention. The treatment is preferably done after the hair has been shampooed and the shampoo rinsed off, but it may be done simultaneously with the shampooing of the hair, the latter being more appropriate when a composition according to the 20 invention is formulated as a shampoo.

Compositions according to the present invention allow the formulation of hair conditioning compositions as a shampoo or as a rinse for treating shampooed hair, using a minimal number of ingredients in comparatively small 25 quantities, still providing a desirable conditioning effect on human hair and, in particular, ensuring a low level of static electricity in the treated hair. In addition, the composition may be easily washed from the treated hair in a normal shampooing of the hair.

In order that the invention may become more clear, there now follows a description of example compositions selected to illustrate the invention. Unless otherwise specified, all parts mentioned are parts by weight.

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A first aqueous emulsion was prepared by emulsion polymerisation of cyclic polydimethylsiloxanes in presence of an alkyl benzene sulphonic acid to provide an emulsion of 35 parts of a first polydiorganosiloxane namely a dimethylhydroxysiloxy end blocked polydimethylsiloxane having a viscosity at 25°C of 100,000 mm<sup>2</sup>/s, dispersed in water and neutralised with triethanolamine, together with minor amounts (i.e. less than 5% of the composition, and preferably less than 3% of the composition) of preservative and a non-ionic emulsifier as stabilizer and 53 parts water.

A second aqueous emulsion of 35 parts of a second polysiloxane namely trimethylsiloxy end blocked polydimethylsiloxane having a viscosity at 25°C of 12,500 mm<sup>2</sup>/s was prepared by emulsion polymerisation in presence of an alkyl benzene sulphonic acid in water and neutralised with triethanolamine, together with minor amounts of preservative and a non-ionic emulsifier as stabilizer and 53 parts water.

A third aqueous emulsion of 60 parts of a third polysiloxane namely a trimethylsilyl end blocked polydimethylsiloxane having a viscosity at 25°C of about 350 mm<sup>2</sup>/s, was formed by dispersing the polysiloxane in about 35 parts water in presence of minor amounts of a non-ionic surfactant, sodium lauryl sulphate and preservatives.

A fourth aqueous emulsion of 1 part of a fourth polysiloxane namely a trimethylsiloxy end blocked polysiloxane consisting of about five dimethyl siloxane units and about five phenylmethyl siloxane units and having a viscosity at 25°C of 100 mm<sup>2</sup>/s, was formed by dispersing the polysiloxane in water in presence of minor amounts of a thickener and cetyl alcohol.

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These emulsions were mixed with the silane  
 $(\text{CH}_3\text{O})_2\text{CH}_3\text{Si}(\text{CH}_2)_3\text{N}^+(\text{CH}_3)_2\text{C}_{13}\text{H}_{27}\text{Cl}^-$   
and with a non-ionic self emulsifying wax in quantities as  
shown in Table 1. Various comparative compositions were  
5 also prepared using components as shown in Table 1. The  
resulting compositions were used to treat swatches of  
virgin European hair and their ability as conditioning  
compositions was assessed by reference to their ability to  
ease the combing of hair, both when wet after shampooing,  
10 and when dry, for their ability to reduce static, and for  
the handle (feel and body) they impart to the hair. The  
tests were carried out as follows. A hair swatch (virgin  
European brown hair) was wetted and washed twice using a  
shampoo, based on 20% sodium lauryl ether sulphate and 3.5%  
15 of linoleic diethanolamide. The hair swatch was rinsed  
well in running water. Then 5ml of the composition under  
examination per 7.8g of hair was applied to the swatch.  
After 1 minute, the hair was combed in order to obtain an  
equal spreading of the conditioner, and the hair swatch was  
20 rinsed for 15 seconds. When the excess of water had been  
removed, the hair swatch was tested for wet combability.  
This was done by passing a fine plastic comb through the  
hair and assessing the ease of combing on a scale of 0 to  
10 with 0 being allocated to swatches combable only with  
25 difficulty or not at all and 10 being allocated to swatches  
showing excellent ease of combing. Results are shown in  
Table 2 in the column "Wet Comb I". After the hair had  
been detangled, the combability was again assessed in the  
same way according to the same scale. Results are shown in  
30 Table 2 in the column "Wet Comb F". The hair swatch was  
then dried in an air-circulating oven at 70°C for one hour.  
When the hair had cooled to room temperature dry comba-  
bility was assessed in the same way as the wet combability,

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results of the initial combing and final combing being recorded in Table 2 in the columns "Dry Comb I" and "Dry Comb F" respectively. The percentage increase in bulk size was measured and recorded in Table 2 as "Body". The static 5 of the hair was assessed by combing the dry hair five times downwards with a plastic comb, and comparing the angle at which the hair spreads out before and after the combing. Performance of the compositions in this test was ranked on a scale 0 to 5 with 0 recording total absence of static. 10 The handle was assessed by feeling the hair and considering its softness, silkiness and body. This test was carried out by a panel of people and the average result is recorded in Table 2.

TABLE I

15	Composition	Component(a)				Component(b)	Ratio
		Aqueous Emulsion		Wax			
	Comparative	1	2	3	4		
	1	0	0	0	0	5	0
	2	0	0	0	0	5	0.5
20	3	0	0	0	0	5	1.0
	4	1	0	0	0	5	0
	5	0	2.5	0	0	5	0
	Illustrative						
	1	2.5	0	0	0	5	0.5
25	2	1.0	0	0	0	5	0.25
	3	1.0	0	0	0	5	1.0
	4	0.5	0	0	0	5	1.0
	5	0	2.5	0	0	5	0.25
	6	0	2.5	0	0	5	0.5
30	7	0	2.5	0	0	5	1.0
	8	0	2.5	0	0	5	2.5
	9	0	0	2.0	0	5	0.5
	10	0	0	0	1.0	0	1.0

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TABLE 2

Composition	Wet Comb		Dry Comb		Body (%)	Static	Handle
	I	F	I	F			
<b>Comparative</b>							
5	1	2	4	4	100	5+	(a)
	2	3	7	3	75	0	(b)
	3	3	6	3	25	0	(c)
	4	3	7	4	20	5	(d)
	5	3	8	5	50	4	(e)
10	<b>Illustrative</b>						
	1	5	8	6	50	2	(f)
	2	3	7	6	50	2	(g)
	3	3	8	6	133	2	(h)
	4	4	9	6	50	1	(i)
15	5	4	9	6	50	5+	(j)
	6	5	9	6	60	2	(j)
	7	4	9	5	50	0	(j)
	8	3	7	6	50	0	(k)
	9	3	7	4	133	4	(l)
20	10	5	9	6	100	0	(m)
	(a) average						
	(b) bodied, slightly heavy but slick						
	(c) bodied, slightly heavy						
	(d) slick, bad static						
25	(e) silky soft, dry ends						
	(f) smooth, soft, silky						
	(g) good body, lively, nice						
	(h) silky; smooth bodied						
	(i) slick, bouncy						
30	(j) smooth, silky						
	(k) slightly heavy						
	(l) soft, slightly heavy						
	(m) very soft						

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The results show that good conditioning benefits can be achieved by use of emulsions containing a polydimethylsiloxane and a quaternary ammonium silane. The comparative compositions 4 and 5 (which contained the polysiloxane and no silane) demonstrated good wet and dry combing properties but poor static control. The comparative compositions 2 and 3 (which contained the silane but no polysiloxane) demonstrated static control but poor conditioning in other respects. The illustrative examples all demonstrated a good combination of these properties, the more preferred compositions demonstrating good combinations of properties, including a low level of static to a surprisingly high level, indicating synergy of the combined ingredients. The combination of beneficial properties obtained on treated hair is most marked when using illustrative compositions 1, 2, 3, 4, 6, 7 and 8, in which compositions the ratio of polydiorganosiloxane:silane lies in the range 0.1:1 to 2.0:1

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CLAIMS

1. A conditioning composition formed by admixture of components comprising (a) an aqueous emulsion of a polydiorganosiloxane having units of the general formula  $R'R_2SiO_{\frac{1}{2}}$  and  $R_aSiO_{\frac{4-a}{2}}$  in which R is selected from the group consisting of

alkyl and aryl groups having no more than 8 carbon atoms, R' is selected from R groups and hydroxyl and a is an integer with a value of from 0 to 2, with (b) a quaternary ammonium compound characterised in that the quaternary ammonium compound is a quaternary ammonium silane of the general (ii)  $R^3_3SiR^4N^+(R^5)_3X^-$  in which each  $R^3$  is selected from the group consisting of alkyl groups having up to 5 carbon atoms in their chain, a hydroxyl group, alkoxy groups, alkoxyalkoxy groups having less than 12 carbon atoms, and a trimethylsiloxy group,  $R^4$  represents a divalent aliphatic hydrocarbon group having from 2 to 10 carbon atoms in its chain linking the silicon and nitrogen atoms and composed of carbon, hydrogen, optionally oxygen in the form of hydroxyl and optionally allyl oxygen in the form of ether linkages, each  $R^5$  represents a monovalent hydrocarbon group, from 1 to 2 groups  $R^5$  having an aliphatic chain composed of on average from 8 to 18 carbon atoms and from 1 to 2 groups  $R^5$  having an aliphatic chain composed of not more than 5 carbon atoms and  $X^-$  represents a monovalent anion.

2. A composition according to claim 1 characterised in that the polydiorganosiloxane has the average general formula (i)  $R'SiR_2[OSiR_2]_nOR_2SiR'$  wherein n has a value such that the polydiorganosiloxane has a viscosity of less than 300,000 mm<sup>2</sup>/s.

3. A composition according to Claim 2 characterised in that the R groups are methyl groups and n has a value such that the polydiorganosiloxane has a viscosity of at least 1000 mm<sup>2</sup>/s.

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4. A composition according to Claim 3 characterised in that when each R' represents a hydroxyl group n has a value such that the polydiorganosiloxane has a viscosity of about 100,000 mm<sup>2</sup>/s and when each R' represents a methyl group n has a value such that the polydiorganosiloxane has a viscosity of about 12,500 mm<sup>2</sup>/s.

5. A composition according to Claim 2 characterised in that more than 10% of groups R are phenyl groups and in that n has a value such that the polydiorganosiloxane has a viscosity in the range 10 to 1000 mm<sup>2</sup>/s

6. A composition according to Claim 1 characterised in that the polydiorganosiloxane provides up to 2% by weight of the composition.

7. A composition according to Claim 1 characterised in that the silane has the formula  
$$(\text{CH}_3)(\text{CH}_3\text{O})_2\text{Si}(\text{CH}_2)_3\text{N}^+(\text{CH}_3)_2\text{C}_{13}\text{H}_{27}\text{Cl}^-.$$

8. A composition according to Claim 1 characterised in that the silane (b) provides up to 5% by weight of the composition.

9. A composition according to Claim 1 characterised in that the ratio by weight of polydiorganosiloxane:silane is less than 2.5:1.

10. A composition according to Claim 9 characterised in that the ratio by weight of polydiorganosiloxane:silane lies in the range 0.1:1 to 2.0:1.

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11. A method of treating human hair comprising the step of applying to the hair a composition according to Claim 1 simultaneously with, or subsequent to, the steps of shampooing and/or rinsing the hair.

# INTERNATIONAL SEARCH REPORT

International Application No.

PCT/GB 88/00962

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) \*

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC<sup>4</sup>: A 61 K 7/075

## II. FIELDS SEARCHED

Minimum Documentation Searched ?

Classification System	Classification Symbols
IPC <sup>4</sup>	A 61 K

Documentation Searched other than Minimum Documentation  
to the Extent that such Documents are Included in the Fields Searched \*

## III. DOCUMENTS CONSIDERED TO BE RELEVANT\*

Category *	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
Y	GB, A, 2173515 (BEECHAM) 15 October 1986 see claims --	1-11
Y	EP, A, 0179347 (REVLON) 30 April 1986 see claims --	1, 6, 7
Y	GB, A, 2144329 (DOW) 6 March 1985 see claims; examples 1-3 cited in the application -----	1-11

- \* Special categories of cited documents:<sup>10</sup>
- "A" document defining the general state of the art which is not considered to be of particular relevance
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## IV. CERTIFICATION

Date of the Actual Completion of the International Search

3rd February 1988

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ANNEX TO THE INTERNATIONAL SEARCH REPORT  
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.  
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